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JUL 31 2007

Amendment and Response

Applicant: Kenneth Kay Smith et al.

Serial No.: 10/790,360

Filed: March 1, 2004

Docket No.: 10014266-1

Title: SYSTEM FOR ERROR CORRECTION CODING AND DECODING

REMARKS

The following remarks are made in response to the Office Action mailed May 1, 2007. In the Office Action, claims 1-15 and 17-27 were rejected and claims 14-17 were objected to. Claim 16 was previously canceled. With this Response, claims 1, 2, 4, 8, 10-13, and 23 have been amended and claims 5-7, 9, and 18-22 have been canceled. Claims 1-4, 8, 10-15, 17, and 23-27 remain pending in the application and are presented for reconsideration and allowance.

Claim Objections under 35 U.S.C. § 112

In the Office Action, claims 7 and 9 were objected to for informalities. Applicants have canceled claims 7 and 9, thereby obviating the objection.

In the Office Action, claims 14, 15, and 17 were objected to for failing to further limit the subject matter of a previous claim. Applicant respectfully submits that the limitations of claims 14, 15, and 17 provide meaningful limitations in that they define more specifically parameters of the system of independent claim 13, consistent with the purpose of a dependent claim, which is to further define an aspect of a limitation of an independent base claim or intervening dependent claim. Applicants note that claim 13 does not the terminology of a Reed Solomon code, but rather the Examiner has applied that terminology. Finally, Applicants note that they have a statutory basis to claim what the Applicants regard is the invention, even though it may be done with language that the Examiner would not have chosen himself or herself. Accordingly, Applicants respectfully requests withdrawal of these objections

Claim Rejections under 35 U.S.C. § 103

In the Office Action, claims 1-4, 11-15 and 17-27 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,772,385 to Ohyama et al. (the Ohyama Patent) in view of U.S. Patent No. 5,805,564 to Kobayashi et al. (the Kobayashi Patent).

Applicants have canceled independent claims 18 and 22.

Applicants' independent claim 1 specifies a system for error correction coding and decoding information with the system comprising first and second encoders and first and second decoders. The first and second encoders are configured to encode information,

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wherein the second encoder has a higher capability than the first encoder. The first encoder generates first parity symbols and the second encoder generates second parity symbols, with a number of the second parity symbols being greater than a number of the first parity symbols. The first and second decoders are configured to recover the information, wherein the first decoder is configured to recover the information using the first parity symbols generated when the first encoder encodes the information, and to provide an indication if the information cannot be recovered. The second decoder recovers the information encoded by the second encoder only if the first decoder cannot recover the information with the second decoder configured to recover the information using the second parity symbols generated when the second encoder.

In contrast, the Ohyama Patent discloses several embodiments in which a second decoder acts on a block automatically following the action of the first decoder on the block. In other words, the second decoder in the Ohyama Patent acts whether or not an error remains after the action of the first decoder, and therefore in the Ohyama Patent, the PO direction error correcting circuit 3022 acts quite differently from the manner recited in Applicants' independent claim 1, in which the second decoder acts only if the first decoder cannot recover the information.

For example, one basic decoding pattern is described in the Ohyama Patent at Column 2, lines 10-34, in which a PO direction error correcting circuit 3022 corrects any errors in data buffer 3024 after a PI direction error correcting circuit 3020 corrects errors in the data in data buffer 3024, with no stated exceptions for the PO direction error correcting circuit 3022 not to act. Indeed, this passage states that "these processes are repeated to correct errors" (see Column 2 at line 28). Accordingly, this basic decoding pattern apparently always includes the action of the second, PO direction error correcting circuit 3022 regardless of the result of the action of the first, PI direction error correcting circuit 3020.

In addition, in the context of syndrome calculation, the Ohyama Patent again describes a second PO directional error correction performed, without exception, after the PI directional error correction. See Column 3, lines 56-67. Moreover, at Column 4, lines 65-68, the Ohyama Patent emphasizes that "Specifically, error correction of the product code is generally performed in each of the directions (PO and PI directions) repeatedly." (emphasis added).

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In other passages of the Ohyama Patent, it is disclosed that the error checking time is reduced by shortening the access time to a memory device and performing the error check in parallel with error correction See Column 9, lines 50-51. Several embodiments identified in the Summary of the Invention (Column 9, line 45 – Column 45) provide for error correction in a second direction after error correction in a first direction, apparently without exceptions for the second error correction, so that the second error correction occurs automatically regardless of the results of the first error correction.

In another example in the Ohyama Patent, a PO error checking process is performed almost concurrently with a PI error checking process. See Column 16, lines 39-41. Accordingly, the statement quoted in the Office Action (“when the check results exhibit nothing abnormal after error correction with respect to any of the PI and PO directions, the information data can immediately be transferred to the host” at Column 16, lines 44-47) does not indicate that a second decoder acts only if a first decoder cannot recover information, as recited in Applicants’ independent claim 1. Rather, the description of the error correcting process for PI and PO directions preceding the cited passage teaches that “when the PI-direction error-correction is completed in the third step, PO-direction error-correcting circuit 12 can access data buffer 14 via data bus 13. Therefore, the fifth step above may be started when the PI-direction error correction in the third step is completed.” See Column 16, lines 19-23. Moreover, regardless of whether the PI-direction error-correcting circuit finds an error or not, a PO-direction error checking/correction takes place in a PO-direction circuit of either PO-direction error-correcting circuit 12 or PO-direction partial error-checking circuit 8. See Column 16, lines 11-15.

In yet another passage, the processing of the PO-direction error correction is stated to occur after a PI-direction error check OR to occur in parallel after PI-direction error correction. At no time, do these passages allow for skipping the PO-direction error correction which is in stark contrast to Applicants’ independent claim 1, in which a second decoder acts to recover information only if the first decoder cannot recover the information. The claim limitation enables fast-tracking error correction, saving the application of the more time consuming second decoder only when necessary. The Ohyama Patent teaches saving time but does not do so by excepting its second PO-direction error correction to limited circumstances. Finally, other passages such as the embodiment (see Column 30, lines 35-67)

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described in association with Figures 26-27 do not teach the criteria under which the second-direction error correction would be avoided.

Finally, as admitted in the Office Action, the Ohyama Patent fails to disclose first and second encoders corresponding to the PO code and the PI code.

The Kobayashi Patent fails to cure the above-identified deficiencies of the Ohyama Patent. In particular, the Kobayashi Patent teaches a decoding process as illustrated in Figure 9 in which data is regenerated with error detection and correction via **both** ECC decoder 47A and ECC decoder 47B with ECC decoder 47B acting **after** ECC decoder 47A. The Kobayashi Patent does not appear to provide any exception to ECC decoder 47B acting on the data after the ECC decoder 47A, which is in stark contrast to Applicants' independent claim 1 in which a second decoder acts to recover information **only if** the first decoder cannot recover the information (i.e. the second decoder does not act if the first decoder can recover the information).

Accordingly, the Kobayahsi Patent fails to cure the deficiency of the Ohyama Patent regarding the claim limitation in Applicants' independent claim 1 of the second decoder acting to recover information only if the first decoder cannot recover the information.

Neither the Ohyama Patent nor the Kobayashi Patent provide the flexibility of Applicants' claimed system which provides enables fast error checking and correction in instances in which few errors occur and which invokes a higher level of complexity only when needed; i.e. more errors occur. This combination provides faster data processing by limiting the application of high capability error correction circuitry, which takes more time and processing power, only to situations in which it is needed. Both the Ohyama Patent and the Kobayashi Patent appear to be locked into the use of a second decoder, resulting in a much more complex and slower error correction scheme that is not adaptable in the manner of the system of Applicants' independent claim 1.

Accordingly, one cannot combine the Ohyama Patent and the Kobayashi Patent and arrive at Applicants' independent claim 1.

For at least these reasons, the Ohyama Patent and the Kobayahsi Patent fail to teach, suggest, or reasonably make obvious Applicants' independent claim 1, and therefore Applicants respectfully submit that independent claim 1 is patentable and allowable over the

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Ohyama Patent and the Kobayashi Patent. Dependent claims 2-4, 8, and 10-12 are believed to be allowable as they further define patentably distinct independent claim 1.

Applicants' independent claim 13 specifies a storage system for error correction coding and decoding information.

For substantially the same reasons previously presented for the patentability of Applicants' independent claim 1, Applicants' independent claim 13 is patentable over the Ohyama Patent and the Kobayashi Patent. In particular, the Ohyama Patent and the Kobayashi Patent fail to teach or suggest: a first encoder that applies first parity symbols and the second encoder that applies second parity symbols which are greater in number than the first parity symbols to enable locating and correcting a larger number of errors than the first encoder, with first and second decoders configured to recover the information, wherein the first decoder acts first to recover the information and the second decoder acts second to recover the information encoded by the second encoder only if the first decoder cannot recover the information, wherein the first and second encoders and the first and second decoders use an error correcting code, as recited in Applicants' independent claim 13. Accordingly, one cannot combine the Murakami Patent and the Kobayashi Patent and arrive at Applicants' independent claim 13.

For at least these reasons, the Ohyama Patent and the Kobayashi Patent fail to teach, suggest, or reasonably make obvious Applicants' independent claim 13, and therefore Applicants respectfully submit that independent claim 13 is patentable and allowable over the Ohyama Patent and the Kobayashi Patent. Dependent claims 14-15 and 17 are believed to be allowable as they further define patentably distinct independent claim 13.

Applicants' independent claim 23 specifies a method of error correction coding and decoding information.

For substantially the same reasons previously presented for the patentability of Applicants' independent claim 1, Applicants' independent claim 23 is patentable over the Ohyama Patent and the Kobayashi Patent. In particular, the Ohyama Patent and the Kobayashi Patent fail to teach or suggest, inter alia: (1) generating a number of second parity symbols from the information, wherein the number of the second parity symbols is greater

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than the number of the first parity symbols; (2) recovering the information from the encoded data block by first using the first parity symbols if the information can be recovered using the first parity symbols; and (3) recovering the information from the encoded data block, after using the first parity symbols, by second using the second parity symbols only if the information cannot be recovered using the first parity symbols, as recited in Applicants' independent claim 23.

Accordingly, one cannot combine the Ohyama Patent and the Kobayashi Patent and arrive at Applicants' independent claim 23.

For at least these reasons, the Ohyama Patent and the Kobayashi Patent fail to teach, suggest, or reasonably make obvious Applicants' independent claim 23, and therefore Applicants respectfully submit that independent claim 23 is patentable and allowable over the Ohyama Patent and the Kobayashi Patent. Dependent claims 24-27 are believed to be allowable as they further define patentably distinct independent claim 23.

In the Office Action, claims 1-15 and 17-27 are rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,311,522 to Murakami (the Murakami Patent) in view of the Kobayashi Patent.

Applicants have canceled independent claims 18 and 22.

Applicants' independent claim 1 specifies a system for error correction coding and decoding information with the system comprising first and second encoders and first and second decoders. The first and second encoders are configured to encode information, wherein the second encoder has a higher capability than the first encoder. The first encoder generates first parity symbols and the second encoder generates second parity symbols, with a number of the second parity symbols being greater than a number of the first parity symbols. The first and second decoders are configured to recover the information, wherein the first decoder is configured to recover the information using the first parity symbols generated when the first encoder encodes the information, and to provide an indication if the information cannot be recovered. The second decoder recovers the information encoded by the second encoder only if the first decoder cannot recover the information with the second decoder configured to recover the information using the second parity symbols generated when the second encoder encodes the information.

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In contrast, the Murakami Patent teaches error correction and checking via an outer code of 4 bytes and an inner code of 8 bytes (Column 1, lines 44-48) in which “after the error correction by the inner code is terminated, error correction by the outer code is performed for correcting the portion which was unable to be corrected by the inner codes. See Column 2, lines 8-12. Accordingly, with the outer code (4 bytes) having a lower size/number than the inner code (8 bytes), the Murakami Patent teaches an arrangement which is the opposite the arrangement recited in the claim limitation of the second encoder generating and applying second parity symbols which have a greater number than the first parity symbols generated and applied by first encoder. Moreover, because the lower numbered outer code (4 bytes) correction is applied second in time (i.e. after) the higher numbered inner code (8 bytes) correction (see Column 1, line 62 – Column 2, line 12), the Murakami Patent teaches further away from and opposite from Applicants’ claim limitation of the second decoder, which applies a higher numbered second parity symbols, acting after the first decoder (which applies a lower number first parity symbols).

Accordingly, the later continuing description of the Prior Art of the Murakami Patent regarding the inner codes and outer codes at Column 2, lines 63-67 would be understood in the context of the Murakami’s description of the inner code having a higher number/size for error detection than the outer code, and hence still teaching away from Applicant’s independent claim 1.

Moreover, the Murakami Patent goes on to teach away from Applicants’ independent claim 1 (e.g., at least the claim limitation of the second decoder acting after the first decoder only if the first decoder cannot recover the information) by teaching and urging that outer code corrections be applied regardless of whether there are no errors, a single error, or multiple errors reported from the inner code correction step. See Table 1 and accompanying description provided at least Column 4, line 37 – Column 5, line 34. The Murakami Patent teaches this arrangement in the belief that a lack of errors found by the inner code correction does not accurately reveal whether or not there are errors in the data because of issues regarding writing new data over old data. Accordingly, the Murakami Patent teaches the use of a second round of error correction (i.e. outer code error correction) that always acts even when no errors are reported from the first round of error correction (i.e. inner code correction), and therefore teaches the opposite of Applicants’ claim in which the second

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decoder acts only if the first decoder cannot recover the information, and therefore the second decoder does not act when the first decoder can recover the information.

Finally, as noted from the structure of the rejection, the Office Action apparently admits that the Murakami Patent fails to disclose first and second encoders.

The Kobayashi Patent fails to the above-identified deficiencies of the Murakami Patent. In particular, the Kobayashi Patent teaches a decoding process as illustrated in Figure 9 in which data is regenerated with error detection and correction via both ECC decoder 47A and ECC decoder 47B with ECC decoder 47B acting **after** ECC decoder 47A. The Kobayashi Patent does not appear to provide any exception to ECC decoder 47B acting on the data after the ECC decoder 47A, which is in stark contrast to Applicants' independent claim 1 in which a second decoder acts to recover information **only if** the first decoder cannot recover the information, and therefore the second decoder does not act if the first decoder can recover the information.

Accordingly, the Kobayashi Patent fails to cure the deficiency of the Murakami Patent regarding the claim limitation in Applicants' independent claim 1 of the second decoder acting to recover information only if the first decoder cannot recover the information.

Neither the Murakami Patent nor the Kobayashi Patent provide the flexibility of Applicants' claimed system which provides enables fast error checking and correction in most instances and invokes a higher level of complexity only when needed. This combination provides faster data processing by limiting the application of slower, high capability error correction circuitry only to situations in which it is needed. Both the Murakami Patent and the Kobayashi Patent are apparently locked into the use of a second decoder, resulting in a much more complex and slower error correction scheme.

Accordingly, one cannot combine the Murakami Patent and the Kobayashi Patent and arrive at Applicants' independent claim 1.

For at least these reasons, the Murakami Patent and the Kobayashi Patent fail to teach, suggest, or reasonably make obvious Applicants' independent claim 1, and therefore Applicants respectfully submit that independent claim 1 is patentable and allowable over the Murakami Patent and the Kobayashi Patent. Dependent claims 2-4, 8, and 10-12 are believed to be allowable as they further define patentably distinct independent claim 1.

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Applicants' independent claim 13 specifies a storage system for error correction coding and decoding information.

For substantially the same reasons previously presented for the patentability of Applicants' independent claim 1, Applicants' independent claim 13 is patentable over the Murakami Patent and the Kobayashi Patent. In particular, the Murakami Patent and the Kobayashi Patent fail to teach or suggest: **a first encoder that applies first parity symbols and the second encoder that applies second parity symbols which are greater in number than the first parity symbols to enable locating and correcting a larger number of errors than the first encoder**, with first and second decoders configured to recover the information, wherein **the first decoder acts first to recover the information and the second decoder acts second to recover the information encoded by the second encoder only if the first decoder cannot recover the information**, wherein the first and second encoders and the first and second decoders use an error correcting code, as recited in Applicants' independent claim 13.

Accordingly, one cannot combine the Murakami Patent and the Kobayashi Patent and arrive at Applicants' independent claim 13.

For at least these reasons, the Murakami Patent and the Kobayashi Patent fail to teach, suggest, or reasonably make obvious Applicants' independent claim 13, and therefore Applicants respectfully submit that independent claim 13 is patentable and allowable over the Murakami Patent and the Kobayashi Patent. Dependent claims 14-15 and 17 are believed to be allowable as they further define patentably distinct independent claim 13.

Applicants' independent claim 23 specifies a method of error correction coding and decoding information.

For substantially the same reasons previously presented for the patentability of Applicants' independent claim 1, Applicants' independent claim 23 is patentable over the Murakami Patent and the Kobayashi Patent. In particular, the Murakami Patent and the Kobayashi Patent fail to teach or suggest, *inter alia*: **(1) generating a number of second parity symbols from the information, wherein the number of the second parity symbols is greater than the number of the first parity symbols; (2) recovering the information from the encoded data block by first using the first parity symbols if the information can be**

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recovered using the first parity symbols; and (3) recovering the information from the encoded data block, after using the first parity symbols, by second using the second parity symbols only if the information cannot be recovered using the first parity symbols, as recited in Applicants' independent claim 23.

Accordingly, one cannot combine the Murakami Patent and the Kobayashi Patent and arrive at Applicants' independent claim 23.

For at least these reasons, the Murakami Patent and the Kobayashi Patent fail to teach, suggest, or reasonably make obvious Applicants' independent claim 23, and therefore Applicants respectfully submit that independent claim 23 is patentable and allowable over the Murakami Patent and the Kobayashi Patent. Dependent claims 24-27 are believed to be allowable as they further define patentably distinct independent claim 23.

In light of the above, Applicants respectfully request withdrawal of the above rejections of claims 1-4, 8, 10-15, 17, and 23-27 under 35 U.S.C. §103 and respectfully request allowance of these claims.

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CONCLUSION

In view of the above, Applicant respectfully submits that pending claims 1-4, 8, 10-15, 17, and 23-27 are in form for allowance and are not taught or suggested by the cited references. Therefore, reconsideration and withdrawal of the rejections and allowance of claims 1-4, 8, 10-15, 17, and 23-27 is respectfully requested.

No fees are required under 37 C.F.R. 1.16(h)(1). However, if such fees are required, the Patent Office is hereby authorized to charge Deposit Account No. 08-2025.

The Examiner is invited to contact the Applicant's representative at the below-listed telephone numbers to facilitate prosecution of this application.

Any inquiry regarding this Amendment and Response should be directed to either Paul S. Grunzweig at Telephone No. (612) 767-2504, Facsimile No. (612) 573-2005 or Wendell Jones at Telephone No. (408) 938-0980, Facsimile No. (408) 938-0980. In addition, all correspondence should continue to be directed to the following address:

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Respectfully submitted,

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CERTIFICATE UNDER 37 C.F.R. 1.8: The undersigned hereby certifies that this paper or papers, as described herein, are being facsimile transmitted to the United States Patent and Trademark Office, Fax No. (571) 273-8300 on this 31st day of July, 2007.

By Paul Grunzweig
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